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Item no. 3443

## **NEW STANDARDS FOR LANDFILLING SITES**

**Proposed Regulatory Standards for New Landfilling Sites  
Accepting Non-Hazardous Waste**

**June 1996**

**Waste Reduction Branch  
Ministry of Environment & Energy**



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## PREFACE

Requirements for the design and operation of landfilling sites are defined in Ontario Regulation 347 under Part V of the Environmental Protection Act. The current regulatory requirements identify general areas of environmental concern which must be addressed before the Ministry of Environment & Energy issues a certificate of approval for a site. Specific details of any potential environmental impacts (eg. on groundwater or surface water) and how they can be addressed are dealt with on a site specific basis in the process of obtaining the certificate of approval.

The absence of specific regulatory standards has been cited as adding uncertainty and delay to the approvals process. By introducing clear, strong landfill standards as proposed in this paper a more efficient and effective approvals process will result. These new standards will also ensure that new landfills in Ontario are second to none in protecting the environment.

The changes proposed in this paper are the result of work carried out by the Ministry with technical advice provided by a consulting team led by M.M. Dillon Limited.

This paper is being released as part of a 60 day public consultation program by the Ministry. Interested individuals and groups are invited to comment on the proposed standards by making written submissions to the Ministry's Waste Reduction Branch. Comments should be sent by August 15, 1996.

Send your comments to:

New Standards For Landfilling Sites  
Waste Reduction Branch  
Ministry of Environment & Energy  
40 St. Clair Ave. West, 7th Floor  
Toronto, Ontario M4V 1M2

Additional copies of this document may be obtained from the Ministry of Environment & Energy by contacting Larry Wilcox at (416) 314-7876 Tel. or (416) 325-4437 Fax.

Item# 34431

## **PROPOSED STANDARDS FOR NEW AND EXPANDED LANDFILLING SITES ACCEPTING NON-HAZARDOUS WASTE**

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### **INTRODUCTION AND PURPOSE**

This paper includes proposals for new detailed landfill standards which will ensure that new landfills in Ontario are second to none in the protection they provide to the environment. By making current requirements more explicit and introducing standards in new areas, the new standards will bring clarity and certainty to the landfill approvals process.

The absence of detailed regulatory standards has been cited by many as adding uncertainty and delay to the approvals process. Existing requirements for the design and operation of landfills are contained in Ontario Regulation 347. Regulation 347 is the general waste management regulation under Part V of the Environmental Protection Act. Although the current regulation identifies general areas of environmental concern, the specific issues and requirements to be addressed are dealt with on a site specific basis during the approvals process. The proposed new standards are intended to remove the uncertainty in the current process and decrease the time and cost of establishing the necessary landfill capacity. The new standards build upon the experience gained with the existing process by codifying many existing approval requirements. In other areas, new or more explicit requirements are proposed.

An efficient and effective waste management program requires that an integrated approach to waste management be taken. Although the Ministry of Environment & Energy continues to emphasize the 3Rs (Reduce, Reuse and Recycle), landfilling is necessary to manage the residuals of 3Rs processing and wastes which are not amenable to reuse or recycling. Even with the availability of incinerators as a disposal option, landfilling remains as a necessary part of waste management, whether to manage incinerator ash or as a preferred disposal option.

The Ministry is interested in receiving comments on the proposed new standards from municipalities, the private sector, environmental or community groups, and any other interested persons. Comments from both those who may be affected by a nearby landfill and those who are responsible for obtaining new landfill capacity are important. All comments will be considered by the Ministry when finalizing the standards.

## WHO IS AFFECTED?

The new standards apply to landfilling sites which accept non-hazardous waste whether the site is owned by a municipality or a private landfill operator. The standards apply to all new landfilling sites and to the expansion of existing sites. The new standards do not apply to small landfills or existing sites which are not being expanded. For purposes of the standards, a small landfill is considered to be a site with a total waste disposal volume of 40,000 cubic metres or less. This size of site would serve a municipality with a population of 1500 persons for approximately 20 years. For these other sites, the existing landfilling site requirements currently practised under the Environmental Protection Act and Regulation 347 will remain in effect.

Some of the proposed standards apply only in certain circumstances. For example, the proposal for collection of air emissions from landfills only applies to relatively large sites (ie. 3.5 million cubic metres or more). In other cases, the specific standards may be inappropriate. For example, sites located in heavy, non-permeable clay can effectively be designed and operated without the engineered liner requirements. Flexibility is built into the requirements to allow local solutions to develop provided there continues to be full health and environmental protection.

## SUMMARY OF THE STANDARDS

The new standards described in this paper include requirements for location, design, operation and closure of sites. The standards apply to all new or expanded landfilling sites (except small sites) accepting non-hazardous waste. The standards cover issues such as:

- location restrictions in the area of public airports, hazardous lands (eg. floodplains) and natural heritage features (eg. significant wetlands),
- requirements for the assessment of hydrogeologic and surface water conditions,
- design specifications including:
  - design criteria for site specific design, and
  - two generic design options,
- a contingency plan for leachate management,

- minimum operating and monitoring requirements,
- mandatory air emissions control for sites with total capacities greater than 3.5 million cubic metres,
- closure and post-closure care provisions, and
- financial assurance requirements for private sector facilities.

The new standards along with a rationale for these requirements are outlined below. A detailed listing of the proposed standards is provided in Appendix A.

### **Location**

#### **Public Airports**

Landfilling sites are a potential hazard to aircraft operations because they can attract flocking birds such as gulls. In order to ensure landfills do not become a threat to aircraft, care should be exercised in the location of landfills. Combined with good operating procedures and a bird control program, any concerns with flight safety should be minimal. The new standards require a bird hazard study be carried out for any new site to be located within 8 kilometres of a public airport.

#### **Hazardous Lands**

New landfilling sites should not be located within floodplains or areas prone to excessive erosion. The building of landfills in these areas unnecessarily increases the risk of damage to the landfill and the release of contaminants to waterways and the environment. The restriction on locating sites within these areas is consistent with the recent Provincial Policy Statement made under the Land Use Planning and Protection Act.

#### **Natural Heritage Features**

Landfilling sites should not be located in environmentally sensitive areas. Significant habitat of endangered and threatened species, significant wetlands and areas of natural and scientific interest should be protected. The proposed standard applies to the natural feature and a surrounding 500 metre buffer zone. The areas identified here are consistent with the recent Provincial Policy Statement made under the Land Use Planning and Protection Act.

## **Site Assessment and Design**

### **Hydrogeology and Surface Water**

An evaluation of the hydrogeologic setting and surface water features in the vicinity of a landfilling site is an important part of determining the suitability, design and monitoring requirements for a site. The landfill standards require that these evaluations be carried out and provide direction on the expected content of the studies. Requirements include a description of regional conditions within 5 kilometres of the site, a detailed study of site conditions, and a geotechnical assessment of the site. For the detailed site study, the standards include provisions such as:

- the drilling of a borehole to a minimum 30 metre depth or bedrock to confirm the regional hydrogeology,
- the drilling of boreholes to characterize the soil to a minimum 10 metre depth below the landfill base or bedrock to characterize site hydrogeology,
- the preparation of plans and descriptions of the surface water courses, water table elevations and groundwater flow patterns, and existing water uses, and
- the analysis of background groundwater and surface water quality for more than 30 contaminants.

### **Design Specifications**

Landfilling sites must be well designed for groundwater and surface water protection, to ensure impacts from site operation are minimized and to facilitate site closure and post-closure care. The design standards are intended to reach a balance between regulatory certainty and the need for site specific design flexibility. The standards require the landfill owner to prepare a detailed site plan and specify, where necessary, design features including:

- site boundaries, buffer zone, waste fill area and contours, on-site roads and structures, and final cover design,
- liner and leachate collection system design,
- control facilities for surface water and landfill gas,
- monitoring facilities for groundwater, leachate, surface water and landfill gas,
- contingency plan concept, and

- site end-use plan.

The design standards also include specific provisions dealing with quality assurance and control, final slope specifications, and design criteria for noise. To ensure the design of the final cover is consistent with the infiltration requirements for groundwater protection, a specific final cover design (ie. minimum permeability) has not been prescribed in the standards. Confirmation that the site has been constructed as designed is addressed by the requirement for completion of a site preparation report prior to the commencement of landfilling operations.

### **Design Criteria For Groundwater Protection**

Groundwater protection is fundamental to good landfill design. Groundwater is often the primary source of rural and urban water supply, and may be a significant component of streamflow. Preventing groundwater contamination is particularly important because of the difficulty and cost of restoration. Once contaminated, it often takes many years to clean-up groundwater.

To protect groundwater resources, landfills must currently be designed to meet stringent contaminant limits in accordance with the Ministry's existing Reasonable Use Guideline. The Reasonable Use Guideline establishes limits for the discharge of contaminants based on existing groundwater quality and the reasonable use of groundwater on adjacent property. The discharge limit is set at the property boundary and at a level which is considered to have only a "trivial" effect on the use of groundwater. As the reasonable use of groundwater is often drinking water, the quality of groundwater may not be degraded by an amount in excess of:

- 50% of the difference between background and the Ontario Drinking Water Objectives for non-health related parameters (eg. chloride), or
- 25% of the difference between background and the Ontario Drinking Water Objectives for health related parameters (eg. lead).

In some cases, however, the Reasonable Use Guideline allows alternative discharge limits. For example, where poor quality or limited supply indicates the reasonable use of groundwater is not drinking water, less stringent discharge limits may be set. These alternative limits would be defined by the Ministry on a case-by-case basis.

The requirements of the Reasonable Use Guideline are included in the new landfill standards. The standard for groundwater protection incorporates the Reasonable Use approach directly in a site specific design option and indirectly in a generic design option.

The site specific design option provides the site owner with flexibility to design the site to suit the local environmental setting provided the Reasonable Use limits for the site can be



met. To provide more certainty for this option, the standards also specify design criteria to be used in site assessment, including:

- the chemical parameters to be modelled,
- waste and leachate characteristics for listed chemical parameters,
- decay constants (ie. half-lives) for the listed organic parameters, and
- the design life of liners and leachate collection systems.

The design criteria specified in the new standards are considered to be very protective and are appropriate for the design of non-hazardous waste landfills.

The standards also include a generic design approach with two generic design options which specify particular designs for the liner and leachate collection systems. The generic designs have been developed such that the Reasonable Use limits for impact on groundwater would be met immediately below the liner system rather than at the property boundary for the landfill. Requiring compliance below the liner system is more protective than the normal Reasonable Use requirement for compliance at the property boundary. Any additional benefit due to contaminant reduction or attenuation at the site (for example, due to the presence of additional silty or clayey soils) is not accounted for when using the generic designs. The generic designs are very protective and would not likely be required if the site specific design approach is followed. The advantage of the generic designs is the added certainty that the design will adequately protect the groundwater environment.

The two generic design options differ with respect to their level of engineering and the maximum quantity of waste which they can handle. The larger design option would allow a greater quantity of waste to be deposited at a particular site but the level, and cost, of engineering would be higher. Although either generic design option could be selected, it is likely that the larger design option would be selected to accommodate a larger site. The choice between the two generic designs, however, would depend on the particular circumstances of each situation.

A conceptual view of a landfill incorporating the generic design approach is shown in Figure 1. The major components of the two generic design options are shown in Figures 2 and 3, and are summarized as follows:

#### 1. Small/Medium Sized Site

This generic design (shown in Figure 2) may be used where no more than **90,000 cubic metres per hectare** of waste disposal volume is to be used and provided the

FIGURE 1  
GENERIC DESIGN APPROACH

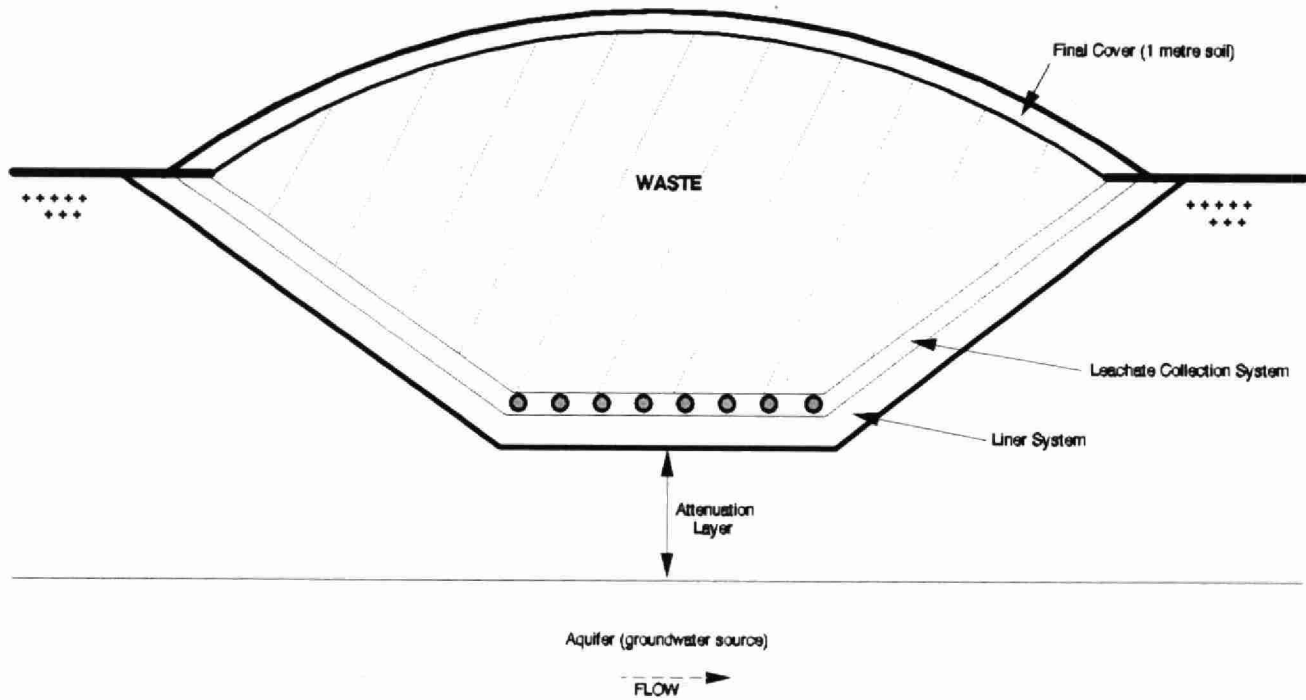


FIGURE 2

**GENERIC DESIGN**

Liner/Leachate Collection System for  
Small/Medium Sized Site

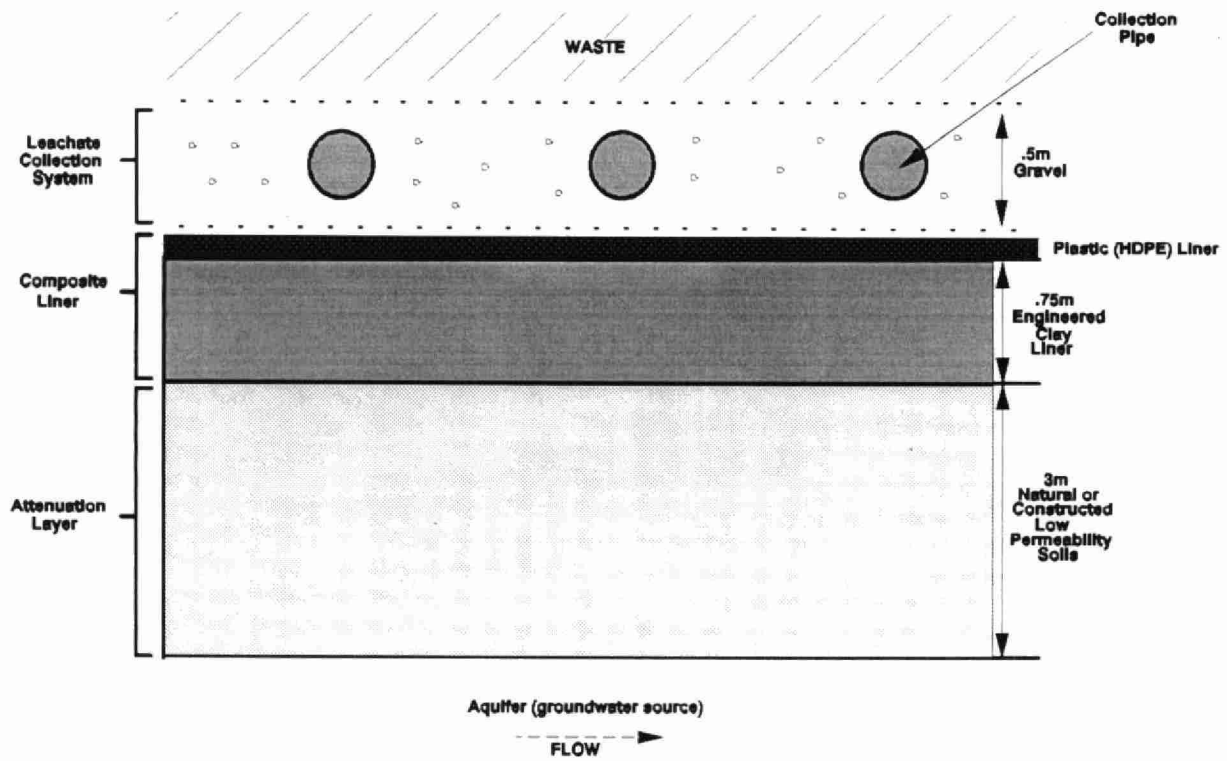
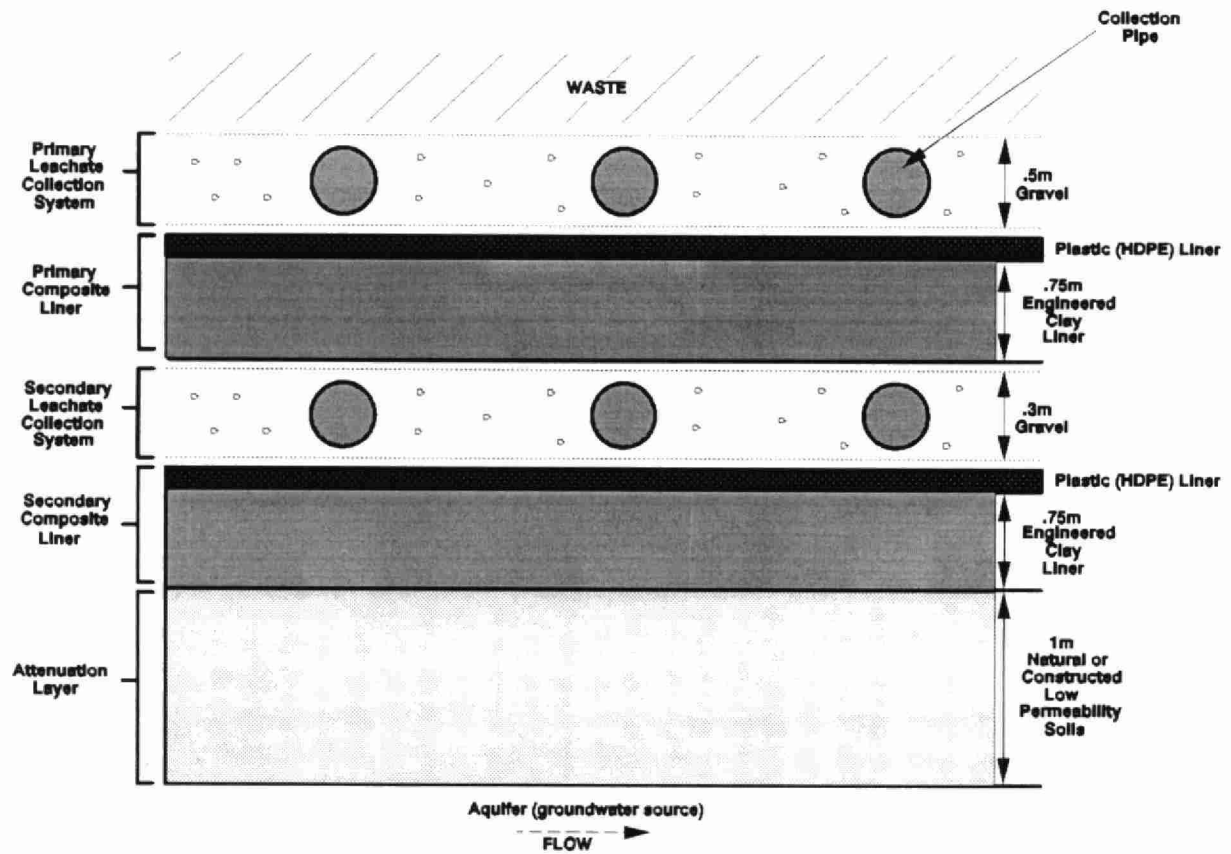


FIGURE 3  
**GENERIC DESIGN**  
Liner/Leachate Collection System for  
Large Sized Site



background chloride concentration in the groundwater aquifer to be protected is no more than **50 mg/L**:

- a. A single **composite liner** consisting of,
  - a 2 millimetre (80 mil) thick high density polyethylene (HDPE) geomembrane liner, and
  - a 0.75 metre thick clay liner below the HDPE liner.
- b. A natural or constructed 3 metre thick **attenuation layer** below the composite liner.
- c. A **leachate collection system** above the composite liner.

## 2. Large Sized Site

This generic design (shown in Figure 3) may be used where no more than **250,000 cubic metres per hectare** of waste disposal volume is to be used and provided the background chloride concentration in the groundwater aquifer to be protected is no more than **50 mg/L**:

- a. Two **composite liners** consisting of:

### Primary (Upper) Composite Liner

- a 2 millimetre (80 mil) thick high density polyethylene (HDPE) geomembrane liner, and
- a 0.75 metre thick clay liner below the HDPE liner;

### Secondary (Lower) Composite Liner

- a 2 millimetre (80 mil) thick high density polyethylene (HDPE) geomembrane liner, and
  - a 0.75 metre thick clay liner below the HDPE liner;
- b. A natural or constructed 1 metre thick **attenuation layer** below the lower composite liner; and
  - c. **Two leachate collection systems** with the first located above the upper composite liner, and the second located between the upper and lower composite liners.

The generic designs were developed using contaminant transport modelling. A basic liner and leachate collection system was selected and the modelling run to assess performance of the system relative to Reasonable Use limits. The modelling was performed using the computer program POLLUTE (© Rowe et al., 1994). Input parameters (eg. waste and leachate characteristics) used in the modelling were the same as those referred to above for the site specific design approach.

### **Landfill Gas**

The natural biodegradation of organic waste in a landfill produces a gas that is either emitted to the atmosphere through the cover or migrates in the soil below ground surface. The major constituents of landfill gas are methane and carbon dioxide. Small amounts of other compounds may also be present in landfill gas.

The methane component of landfill gas is a potential energy source but also poses an explosion hazard if it becomes trapped in enclosed spaces at levels ranging from 5 to 15 percent by volume. Methane gas, and to a lesser extent carbon dioxide, are "greenhouse" gases which contribute to global warming. The trace components of landfill gas such as hydrogen sulphide, mercaptans and non-methane organic compounds may create nuisance odours and degrade air quality.

The new landfill standards address both the sub-surface migration of landfill gas as well as air emissions. The standards require an assessment of the potential generation and migration of landfill gas, and set limits for control.

Sub-surface migration is addressed by specifying maximum levels of methane permitted to migrate off-site and accumulate in buildings at the site. The limits specified in the standards for sub-surface migration are:

- less than 5 percent methane gas at the property boundary,
- less than 1 percent methane in, or in the foundation of, an on-site building, and
- methane from the site should not be present in, or in the foundation of, a building located off-site.

For emissions to air, the standards require mandatory collection of landfill gas for new or expanded sites with a total waste disposal volume greater than 3.5 million cubic metres. This volume equates to approximately 2.5 million tonnes of waste. Where a site of this size will not receive significant quantities of organic waste, gas collection may not be required.

## **Operation and Monitoring**

### **Operation and Maintenance Procedures**

Good operation and maintenance procedures must be implemented at a landfilling site to ensure environmental control works continue to function as designed and for as long as they are needed. Operation and maintenance procedures are also important in minimizing potential nuisance impacts such as noise, odour and dust. The new landfill standards require that the landfill owner specify the procedures to be followed at a particular site. The standards identify the issues to be addressed in the operations plan and give direction on acceptable procedures for some activities. The operations plan for a site covers activities including:

- a waste control program to identify unacceptable wastes and ensure regulated hazardous wastes are not accepted,
- site supervision and security,
- cover material type, source and stockpiling,
- operation and maintenance procedures for environmental control and monitoring facilities,
- procedures to control noise, odour and dust,
- any procedures, such as enhanced water infiltration, intended to shorten or otherwise alter the contaminating life span of the site, and
- a complaint response plan to address public concerns with site operations.

The new standards provide specific direction on requirements such as daily and intermediate cover, record keeping and monitoring. Continuing opportunities for public involvement and specific requirements for leachate, groundwater and surface water monitoring are also included.

### **Groundwater and Surface Water Monitoring**

Regular monitoring of groundwater and surface water is necessary to demonstrate that a landfilling site is performing as designed and to identify any potential problems. The new landfill standards define the parameters and the frequency of monitoring. Monitoring of the quantity and quality of leachate produced within the site itself is also required. The locations for monitoring would be determined on a site specific basis.

The **groundwater and leachate** monitoring program includes the following:

- annual monitoring for a comprehensive list of inorganic and organic parameters including metals and volatile organics,
- quarterly monitoring for a reduced list of indicator parameters,
- monthly measurements of leachate mounding within the waste and continuous monitoring of leachate quantities removed from the site, and
- where requested by nearby property owners, annual monitoring of domestic wells.

The **surface water** monitoring program includes the following:

- semi-annual monitoring for a comprehensive list of inorganic and organic parameters including metals and volatile organics, and characteristics such as flow, temperature and dissolved oxygen,
- quarterly monitoring for a reduced list of indicator parameters, and
- annual monitoring of biological features (ie. benthic, or bottom dwelling, organisms such as flies and worms).

An assessment of the monitoring results relative to the expected impacts must be carried out by the site owner and included along with the monitoring results in an annual site monitoring report.

### **Public Liaison Committee**

The opportunity for continuing public input in the activities taking place at a landfilling site is a requirement of the proposed new standards. Questions and comments from the public and local representatives are important to helping maintain a commitment to high standards of operation and environmental protection at a site. The new standards require that the landfill owner form a public liaison committee and host meetings regularly during the year. The invitation to participate on the public liaison committee is to be extended to nearby residents, and the local and upper tier municipalities. Copies of the annual operations report for the site and any submissions to the Ministry are to be provided to the liaison committee. The specific terms of reference for the operation and involvement of the committee beyond the requirements of the standards would be determined on a site specific basis.



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## **Annual Report**

The proposed standards require the site owner to prepare an annual report that documents the results of site impact monitoring, the current status of site development and capacity usage, upcoming phases of site development and any operational concerns. Based on the annual report and the day-to-day reviewing of site activities, recommendations for possible improvements to site design or operations are to be identified in the annual report. For private sector landfills, the standards also require that an update of the financial assurance estimate for the site be provided. An annual report summarizing site operations during the previous year is an important tool in monitoring site activities and environmental compliance. Preparation of an annual report also reinforces the need for continual improvement in site operations.

## **Closure and Post-Closure Care**

Once a landfilling site has stopped receiving waste, it must be closed in a manner which ensures the long term protection of the environment and is aesthetically acceptable. Site closure activities involve the progressive closure of portions of the fill area as they reach final approved contours. While the closure of some smaller sites may only require the application of final cover and limited post-closure monitoring and maintenance, larger sites likely require significant ongoing care including the operation and maintenance of leachate and gas control systems.

The post-closure period (or contaminating life span) for a landfill depends on the environmental setting, the level of engineering, and the expected service life of the engineered works. The post-closure period may extend from many decades to several hundreds of years. The duration of the post-closure period may also depend on the type of waste accepted and whether operational procedures such as enhanced infiltration have been practised to facilitate waste stabilization.

The proposed landfill standards require the landfill owner to prepare a report detailing site closure and post-closure care. The report is to be prepared at least two years before the expected date of closure or once 90 percent of the site has been filled. The report updates and provides more details on the closure and post-closure activities originally outlined in the design report for the site. Information to be included in the closure and post-closure care report includes:

- notification procedures of upcoming site closure,
- completion and ongoing maintenance of the final cover and landscaping.

- the planned end use for the site,
- final construction of any environmental control or monitoring facilities,
- ongoing operation and maintenance of any environmental control or monitoring facilities, and
- for private sector landfills, an update of financial assurance requirements.

To help ensure the site continues to perform as designed, the standards also require an annual post-closure report be prepared summarizing the results of site monitoring and continued operation and maintenance requirements for the environmental control works. Post-closure care will be required for as long as the site poses a potential concern to the environment.

#### **Financial Assurance**

Financial assurance is needed for private sector landfills to ensure funds are available to carry out any necessary monitoring or maintenance activities, and to correct potential environmental problems. Currently the Ministry requires financial assurance by imposing conditions on the certificate of approval for each private sector landfill. Financial assurance is normally provided as a cash deposit, letter of credit or bond. Financial assurance is not required for a site owned by a municipality.

Under the proposed landfill standards, the cost estimates for site closure and post-closure care are to be determined on a case-by-case basis. As there is considerable experience with these activities, reasonable estimates can be made for each landfill based on site design, the level of engineering and environmental setting. The new standards require that the closure and post-closure funding be accumulated during the operating life of the site, with all funding to be in place five years before closure or upon filling 80 percent of the site.

The landfill standards also require financial assurance be provided for the leachate contingency plan. Although it is not expected that the contingency plan would need to be implemented, some monies must be available in case environmental problems arise. To simplify the financial assurance requirements for contingency plans, the new standards propose that the amount be determined on a per tonne basis. Based on a review of contingency funds provided for existing sites, a fifty cents per tonne amount has been proposed in the landfill standards. The total amount of the contingency fund for a site would be determined by multiplying the fifty cents per tonne amount by the total tonnage capacity of the site. This amount would then be adjusted to account for the date when the site is actually to be closed. While being consistent from site to site, this approach still recognises that the amount of financial assurance should reflect the size of the landfill (ie. a larger site generates a larger fund). Funds for the contingency plan would be accumulated during the



operating life of the site, with all funding to be in place five years before closure or upon filling 80% of the site.

As an alternative to establishing separate contingency funds for each private sector landfill, the standards also include a clause allowing a single fund to be established for a group of sites. A group financial assurance plan can be viewed in a similar manner as insurance in the sense that they are for unexpected costs. The specific details of such a group plan would have to be acceptable to the Ministry.

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